

Peritoneal dialysis in patients with vascular access problems

Diálise peritoneal em doentes com problemas de acesso vascular

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ABSTRACT

Vascular access problems are an important cause of compulsory transfer to peritoneal dialysis. Surprisingly, little is known about the effect of these transfers on peritoneal dialysis adequacy, patient or technique survival.

We have analysed retrospectively a cohort of 75 patients treated at the Peritoneal Dialysis Unit of Centro Hospitalar Lisboa Norte – Hospital de Santa Maria during the year 2011. ‘Vascular access problems’ were defined clinically. Patient characteristics, peritoneal dialysis features and survival were compared between patients with (group 1, n = 14) and without vascular access problems (group 2, n = 61).

In group 1, significantly more patients were Black and had been transferred from haemodialysis, with a considerably longer time spent on this technique. These patients were more likely to be anuric, with an inferior daily total fluid removal, lower renal and total creatinine clearance, and poorer Kt/V for urea. Peritoneal clearance and peritoneal membrane transport type did not differ between groups. Group 1 had a considerably higher exit site infection and peritonitis rate, and a lower albumin level. No significant differences were observed in unadjusted patient or technique survival between the two study groups. In the Cox multiple regression model, only a higher total creatinine clearance significantly and positively influenced the technique survival.

In conclusion, the prevalence of vascular access problems of the Peritoneal Dialysis Unit was 18.7% and it justified 78.6% of transfers from the Haemodialysis Unit. These were not the ideal patients for peritoneal dialysis. Nonetheless, our data suggest that the outcome (patient and technique survival) of patients with mandatory transfer to peritoneal dialysis because of vascular access problems is similar to that achieved in patients without vascular access problems. Total creatinine clearance appeared as an independent protective factor of technique survival.

Key-Words: Haemodialysis; peritoneal dialysis; survival; vascular access problems.

■ RESUMO

Os problemas de acesso vasculares são uma causa importante de transferência obrigatória para diálise peritoneal. Surpreendentemente, pouco é conhecido sobre os efeitos destas transferências na adequação da diálise peritoneal, sobrevida do paciente ou da técnica.

Analisámos retrospectivamente um grupo de 75 pacientes tratados na Unidade de Diálise Peritoneal do Centro Hospitalar Lisboa Norte – Hospital de Santa Maria no ano 2011. Os ‘problemas de acesso vascular’ foram definidos clinicamente. As características e sobrevida dos pacientes foi comparada entre os doentes com (grupo 1, n = 14) e sem problemas de acesso vascular (grupo 2, n = 61).

No grupo 1 havia um número maior de doentes de raça negra e transferidos de hemodiálise, com um tempo dispendido nesta técnica consideravelmente superior. Estes doentes eram mais propensos a anúria, menor remoção total de fluidos/dia, menor depuração de creatinina renal e total, e inferior Kt/V da ureia. A depuração de creatinina peritoneal e o tipo de transportador de membrana peritoneal não divergiu entre os grupos. As taxas de infecção do orifício de saída e peritonite foram superiores no grupo 1, a albuminémia era menor nestes doentes. Não se verificaram diferenças na sobrevida dos doentes ou técnica (método *Kaplan-Meier*). No modelo de regressão *Cox*, apenas valores superiores de depuração de creatinina total influenciaram de forma significativa e positiva a sobrevida da técnica.

Em conclusão, na Unidade a prevalência de problemas de acesso vascular foi 18.7%, e isso justificou 78.6% das transferências da Unidade de Hemodiálise. Estes não seriam os doentes ideais para diálise peritoneal. No entanto, os dados sugerem que a sobrevida (paciente e técnica) de doentes com transferência obrigatória para diálise peritoneal por problemas de acesso vascular é similar à de doentes sem problemas de acesso vascular. A depuração de creatinina total surgiu como fator protetor independente da sobrevida da técnica.

Palavras-chave: Diálise peritoneal; hemodiálise; problemas do acesso vascular; sobrevida.

■ INTRODUCTION

In the concept of integrated care, haemodialysis (HD) and peritoneal dialysis (PD) are regarded as complementary methods of renal replacement therapy and these two modalities should be used to achieve the best patients outcome^{1,2}.

In an integrated care model, it is well recognized that the technique survival remains unsatisfactory in PD, with as many as 10–20% of PD patients being transferred annually to HD^{3,4}. The major causes of PD technique failure are peritonitis and ultrafiltration failure^{3,5-9}. Technique failure in HD is far less common. However, as HD is more prevalent than PD, a substantial percentage of PD patients have been transferred from HD, ranging from 15 to 25% in many PD programmes^{3,7,10,11}. The main reasons for such transfers are vascular access problems, cardiac disease and patient preference¹².

The clinical course of patients entering PD therapy because of vascular access problems is scarcely known. Based on this concern, the aim of this work was to assess patient characteristics, PD adequacy and outcome in this group of patients.

■ SUBJECTS AND METHODS

■ Study design

This observational cross-sectional study enrolled 75 patients attending the PD unit of Centro Hospitalar Lisboa Norte – Hospital de Santa Maria, Portugal, from January to December 2011. No patients treated during that time were excluded from the analysis or were lost to follow-up.

Patient characteristics, PD features and outcome (patient and technique survival) were compared

between PD patients with and without vascular access problems (group 1 and 2, respectively).

■ Definitions

Patients 'transferred from HD' were defined as those who had been treated with HD for ≥ 3 consecutive months and HD had been chosen initially as a long-term therapy. Patients who were treated temporarily with the use of central vein catheters in a bridge-in period before starting PD were not included in this group. Patients with 'vascular access problems' were defined clinically (≥ 2 cases/patient of primary failure of arteriovenous fistula, ≥ 2 cases/patient of arteriovenous fistula or graft thrombosis and patients with vascular access exhaustion). Patient comorbidity was assessed according to Charlson comorbidity index¹³ (not age adjusted). Patient priority in kidney transplantation was defined through clinical classification as super-urgent (only ABO blood group compatibility and negative crossmatch required) and U1 or U2 (1 or 2 human leukocyte antigen locus compatibility required). Clinical and laboratory parameters were evaluated at the end of the observation period. 'Total fluid removal' was calculated from the sum of 24 hours peritoneal ultrafiltration and diuresis. The latest clearance studies and peritoneal equilibration tests with 3.86% glucose were analysed. The Watson formula¹⁴ was used to estimate total body water in the Kt/V calculations, and the Du Bois equation¹⁵ was employed for calculation of body surface area in normalized creatinine clearance.

■ Survival analysis

In patient survival analysis, only death was considered as a final event and patients were censored at transplantation, transfer to HD, recovery of renal function or at the end of the observation period.

In the technique survival analysis, both transfer to HD and super-urgent transplantation were regarded as final events, and patients were censored at U1 or U2 transplantation, recovery of renal function, death or at the end of the study. Short-term treatment switch to HD following catheter removal due to peritonitis or other technical problems, with a subsequent return to PD, was ignored in the analysis.

■ Statistical analysis

Parametric variables were expressed as mean \pm standard deviation (SD) and were compared using student's *t*-test. Non-parametric variables were expressed as median and interquartile range (IQR) and compared using Mann-Whitney test. Categorical variables were expressed in percentages and were compared using the chi-squared test. Survival was analysed by Kaplan-Meier and Cox proportional hazards modelling. All *p*-values were 2-tailed and values < 0.05 were considered statistically significant. Confidence intervals included 95% of predicted values. Analyses were carried out using SPSS software (version 20; SPSS Inc. Chicago IL, USA).

■ RESULTS

■ Population

Of 75 patients enrolled in the study, 25 were incident patients. Peritoneal dialysis was the initial method of renal replacement therapy in 52 patients, 18 had been transferred from HD to PD (owing to vascular access problems in 11, patient preference in six and Heparin-induced thrombocytopenia in one), and five patients had come into PD after a renal allograft loss.

The median observation period was 10.8 months (interquartile range 6.2–12 months). During the time of observation, 10 patients were transferred to HD, kidney transplantation was performed in seven patients (super-urgent in two), recovery of renal function occurred in four patients and there was one death. Fifty-three patients were still on PD at the end of the study.

The prevalence of vascular access problems of the Peritoneal Dialysis Unit was 18.7% (group 1, $n = 14$). Patient characteristics and PD features of the two groups are given in Table 1.

■ Patients with vascular access problems

In group 1, relatively more patients were Black and had been transferred from HD, with a considerably

Table I

Patients' characteristics and peritoneal dialysis features

Parameter	Group 1 (n = 14)		p-value
	Vascular access problem	No vascular access problem	
Age (years; mean ± SD)	44 ± 19	54 ± 19	NS
Male (%)	64.3	63.9	NS
Caucasian / Black (%)	35.7 / 64.3	91.8 / 8.2	< 0.001
Body mass index (kg/m ²)	23.2 ± 4	24.9 ± 4	NS
Charlson comorbidity index (median and IQR)	3 (2 – 3.25)	2 (2 – 4)	NS
Diabetes mellitus (%)	0	14.8	NS
Provenance (%)			
– Primary peritoneal dialysis	14.3	82	< 0.001
– Renal allograft loss	7.1	6.6	NS
– Transferred from haemodialysis	78.6	11.5	< 0.001
Peritoneal Dialysis: free choice / mandatory (%)	0 / 100	98.4 / 1.6	< 0.001
Previous time on haemodialysis (months; mean ± SD)	58.7 ± 38.4	5.7 ± 4.9	0.002
Time on peritoneal dialysis (months; median and IQR)	12 (6.8 – 27.8)	20 (8.5 – 35.5)	NS
CAPD / APD (%)	21.4 / 78.6	11.5 / 88.5	NS
High-dose APD (%)	63.6	20.4	0.003
Anuria (%)	50	15	0.004
Total fluid removal/ day (L; mean ± SD)	1.3 ± 0.5	1.7 ± 0.6	0.043
D/P creatinine at 4 hours (mean ± SD)	0.73 ± 0.06	0.72 ± 0.1	NS
Weekly renal creatinine CL (L/1.73m ² ; mean ± SD)	21.6 ± 26	47.3 ± 34	0.013
Weekly peritoneal creatinine CL (L/1.73m ² ; mean ± SD)	40.5 ± 12.3	36.5 ± 14.5	NS
Weekly total creatinine CL (L/1.73m ² ; mean ± SD)	62 ± 1.9	84 ± 27.6	0.009
Weekly KT/V for urea (mean ± SD)	2.1 ± 0.4	2.4 ± 0.4	0.049
Protein catabolic rate (g/kg/day; mean ± SD)	0.96 ± 0.2	1 ± 0.2	NS

Standard deviation (SD), Interquartile range (IQR), Continuous ambulatory peritoneal dialysis (CAPD), Automated peritoneal dialysis (APD), Clearance (CL)

longer time spent on this technique. As expected, group 1 had an appreciably higher prevalence of anuria, lower renal creatinine clearance and daily total fluid removal. The D/P values for creatinine at 4 hours did not differ between groups. Peritoneal clearance did not reach a significant difference even though the greater frequency of high-dose automated peritoneal dialysis (APD) in group 1. Both weekly Kt/V for urea and total

creatinine clearance were much lower in this group (Table I).

Group 1 had a considerably lower albumin level (Table II). The prevalence of peritoneal catheter exit site infection was significantly higher in group 1 when compared to patients on group 2 (0.70 versus 0.24 episode/patient.year, $p < 0.001$), as well as the rate of peritonitis (0.80 versus 0.23 episode/patient.year, $p < 0.001$).

Table II

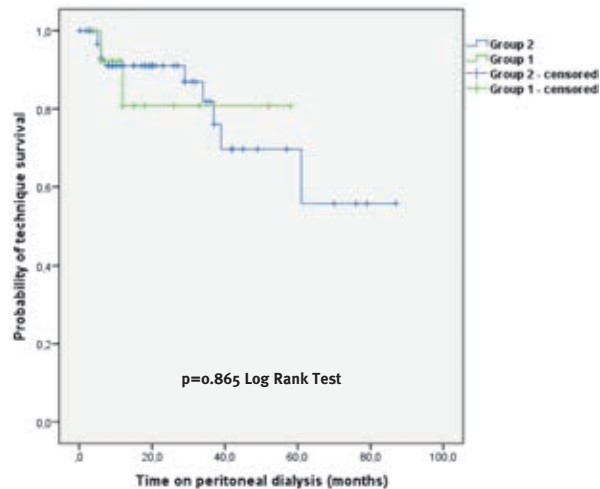
Laboratory data at the end of the observation period

Parameter	Group 1 (n = 14)		p-value
	Vascular access problem	No vascular access problem	
Haemoglobin (g/L; mean ± SD)	11 ± 1.9	11.6 ± 1.4	NS
Albumin (g/dL; mean ± SD)	3.6 ± 0.3	3.9 ± 0.5	0.010
Calcium corrected for Albumin (mmol/L; mean ± SD)	2 ± 0.3	2.2 ± 0.2	NS
Phosphorus (mmol/L; mean ± SD)	1.5 ± 0.4	1.6 ± 0.3	NS
Intact parathormone (pg/dL; mean ± SD)	689 ± 435	580 ± 425	NS
C-reactive protein (mg/dL; median ± IQR)	1.15 (0.28 – 2.94)	0.39 (0.06 – 1.48)	NS

Standard deviation (SD), Interquartile range (IQR)

Figure 1

Technique survival analysis performed by the Kaplan–Meier method in the studied cohort



Peritoneal dialysis patients with (group 1) and without vascular access problems (group 2)

■ Patient survival

The single patient who died during the study was from group 2. There was no significant difference in unadjusted patient survival between groups ($p = 0.796$).

In the Cox proportional hazard model (adjusted for age, Charlson comorbidity index and previous HD), the relative risk of death was not significantly higher in patients who had vascular access problems ($p = 0.994$).

■ Technique survival

Of patients from group 2, four recovered renal function, 10 were transferred to HD and five underwent U1 or U2 transplantation. In group 1, there were two exits for super-urgent transplantation. There was no difference in unadjusted technique survival between the two study groups (Fig. 1).

In Cox multiple regression technique survival analysis, PD patients with and without vascular access problems (group 1 or 2) were included into the model together with age, Charlson comorbidity index, previous HD, anuria, daily total fluid removal, weekly total creatinine clearance, serum albumin,

Table III

Results of Cox multiple regression technique survival analysis in the studied cohort

Parameter	Technique survival	
	Relative risk (95% Confidence interval)	p-value
Age	1.04 (0.97 – 1.12)	NS
Charlson comorbidity index	2.49 (0.92 – 6.77)	NS
Provenance: transferred from haemodialysis	0.74 (0.02 – 24.08)	NS
Anuria	0.75 (0.03 – 20.53)	NS
Total fluid removal/ day	1.01 (0.99 – 1.03)	NS
Weekly total creatinine CL	0.93 (0.88 – 0.99)	0.024
Albumin	0.16 (0.005 – 5.93)	NS
Peritoneal catheter exit site infection	0.34 (0.01 – 8.79)	NS
Peritonitis	0.67 (0.07 – 6.91)	NS
Group 1 versus Group 2	0.23 (0.002 – 26.22)	NS

Clearance (CL), PD patients with (group 1) and without vascular access problems (group 2)

peritoneal catheter exit site infection and peritonitis rate. In this model, there was no difference in technique survival between groups, and only weekly total creatinine clearance significantly and positively influenced technique survival (Table III).

■ DISCUSSION

Both HD and PD are interchangeable and complementary renal replacement therapy modalities, along with kidney transplantation. Patients can be transferred from one modality to another for various reasons, and the cause of the transfer may strongly affect the outcome¹¹. Vascular access problems are an important reason of mandatory transfer to PD.

In this single centre observational study, PD was the primary therapy for the majority of patients. For the remaining, 24% had been treated previously with HD and 6.7% had entered PD after a failed transplant. The prevalence of vascular access problems was 18.7%, and it was the cause of transfer from HD to PD in 78.6% patients, with mandatory transfer to PD in all cases.

The elevated percentage of patients transferred from HD was probably due to the fact that the Centre receives HD patients from Portuguese-speaking African countries. These patients had long-standing complications in HD, predominantly vascular access problems.

In some studies^{11,12,16} most of the patients were transferred from HD to PD as a result of vascular problems. Similarly to our study, Koc *et al.*¹¹ has reported a 70% frequency of compulsory transfer to PD due to vascular problems.

In our PD Unit, the two study groups did not differ substantially, except for more Black patients and a significantly higher prevalence and median time on HD in group 1. Therefore, it was not surprising that these patients were more likely to be anuric, with an inferior daily total fluid removal and lower renal creatinine clearance. Despite the greater frequency of high-dose APD in patients with vascular problems, peritoneal clearances did not differ significantly. Both weekly Kt/V for urea and total creatinine clearance were much lower in these patients, because of reduced residual renal function.

Peritoneal catheter exit site infection and peritonitis rate were higher in group 1. Black race^{17,18}, transfer from HD to PD¹⁸ and loss of residual renal function¹⁹ were independent predictors of peritonitis. Given the prevalence of all these features in the case-mix of group 1, it might explain their elevated peritonitis rate.

The lower albumin level in group 1 was possibly secondary to the inflammatory state. These patients had higher C-reactive protein levels, although it did not reach statistical significance in the analysis.

It has to be taken into account that patients who are transferred between renal replacement therapy modalities due to problems with one technique are often negatively 'selected' and are predisposed to lower survival, irrespective of the direction of transfer¹⁰. However, the selection may also be positive, as many fragile patients might have not survived to the point of transfer, leaving the more 'healthy' population¹².

In our study, there was no difference in survival between patients with and without vascular access problems. Liberek *et al.*¹² also did not detect any influence of previous HD on patient survival, in contrast to most papers^{3,10,11,16,20-22}.

In our series, technique survival did not diverge between patients with and without vascular access problems. A higher total creatinine clearance was

found to be independently associated with a longer PD technique survival. None of the other predictor variables influenced technique survival, namely peritoneal dialysis-related infections. This latter fact is in disagreement with the literature¹² and can be explained by the short follow-up of the study.

Peritoneal dialysis was a mandatory choice for all our PD patients with vascular access problems, and many of these patients were not obviously the ideal candidates for PD.

In our view, these results should be interpreted within the context of the study's limitations. As in all observational studies, the possibility of residual confounding or misclassification of outcomes cannot be excluded. Our case-mix was small, a joint analysis of incident and prevalent patients was performed, patients with vascular access problems (from primary PD, after renal allograft loss and transferred from HD) were analysed altogether, and our follow-up was short. Finally, there was only one death in the study period, which could compromise the evaluation of patient survival.

Future prospective multicentre studies should be ideally conducted in order to confirm the findings presented herein.

In conclusion, the prevalence of vascular access problems of the PD Unit was 18.7% and it justified 78.6% of transfers from HD. These were not the ideal patients for PD (lower residual renal function and fluid removal, higher peritoneal dialysis-related infections rate). Nonetheless, our data suggest that the outcome (patient and technique survival) of patients with mandatory transfer to PD because of vascular access problems is similar to that achieved in patients without vascular access problems. Finally, total creatinine clearance appeared as an independent protective factor of PD technique survival.

Conflict of interest statement: None declared.

References

1. Coles GA, Williams JD. What is the place of peritoneal dialysis in the integrated treatment of renal failure? *Kidney Int* 1998;54(6):2234-2240.
2. Lameire N, Van Biesen W, Vanholder R. The role of peritoneal dialysis as first modality in an integrative approach to patients with end-stage renal disease. *Perit Dial Int* 2000;20(Suppl 2):134-141.

3. Guo A, Mujais S. Patient and technique survival on peritoneal dialysis in the United States: evaluation in large incident cohorts. *Kidney Int Suppl* 2003;88:S3–12.
4. Afolalu B, Troidle L, Osayimwen O, Bhargava J, Kitsen J, Finkelstein FO. Technique failure and center size in a large cohort of peritoneal dialysis patients in a defined geographic area. *Perit Dial Int*. 2009;29(3):292–296.
5. Davies SJ, Phillips L, Griffiths AM, Russell LH, Naish PF, Russell GI. What really happens to people on long-term peritoneal dialysis? *Kidney Int* 1998;54(6):2207–2217.
6. Lupo A, Tarchini R, Carcarini G, *et al*. Long-term outcome in continuous ambulatory peritoneal dialysis: a 10-year-survey by the Italian Cooperative Peritoneal Dialysis Study Group. *Am J Kidney Dis* 1994;24(5):826–837.
7. Van Biesen W, Vanholder RC, Veys N, Dhondt A, Lameire NH. An evaluation of an integrative care approach for end-stage renal disease patients. *J Am Soc Nephrol* 2000;11(1):116–125.
8. Maiorca R, Carcarini GC, Brunori G, *et al*. Comparison of long-term survival between hemodialysis and peritoneal dialysis. *Adv Perit Dial* 1996;12:79–88.
9. Van Biesen W, Dequidt C, Vijt D, Vanholder R, Lameire N. Analysis of the reasons for transfers between hemodialysis and peritoneal dialysis and their effect on survivals. *Adv Perit Dial* 1998;14:90–94.
10. Heaf JG, Løkkegaard H, Madsen M. Initial survival advantage of peritoneal dialysis relative to haemodialysis. *Nephrol Dial Transplant* 2002;17(1):112–117.
11. Koc Y, Unsal A, Basturk T, *et al*. Is there impact of mortality prior hemodialysis therapy in peritoneal dialysis patients? *Nefrologia* 2012;32(3):335–342.
12. Liberek T, Renke M, Skonieczny B, *et al*. Therapy outcome in peritoneal dialysis patients transferred from haemodialysis. *Nephrol Dial Transplant* 2009;24(9):2889–2894.
13. Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chronic Dis* 1987;40(5):373–383.
14. Watson PE, Watson ID, Batt RD. Total body water volumes for adult males and females estimated from simple anthropometric measurements. *Am J Clin Nutr* 1980;33(1):27–39.
15. Du Bois D, Du Bois EF. Clinical calorimetry. Tenths paper to estimate the approximate surface area if height and weight be known. *Arch Int Med* 1916;17:863–871.
16. Sipahioglu MH, Aybal A, Unal A, Tokgoz B, Oymak O, Utas C. Patient and technique survival and factors affecting mortality on peritoneal dialysis in Turkey: 12 years' experience in a single center. *Perit Dial Int* 2008;28(3):238–245.
17. Kim GC, Vonesh EF, Korbet SM. The effect of technique failure on outcome in black patients on continuous ambulatory peritoneal dialysis. *Perit Dial Int* 2002;22(1):53–59.
18. Nessim SJ, Bargman JM, Austin PC, Nisenbaum R, Jassal SV. Predictors of peritonitis in patients on peritoneal dialysis: results of a large, prospective Canadian database. *Clin J Am Soc Nephrol* 2009;4(7):1195–1200.
19. Han SH, Lee SC, Ahn SV, *et al*. Reduced residual renal function is a risk of peritonitis in continuous ambulatory peritoneal dialysis patients. *Nephrol Dial Transplant* 2007;22(9):2653–2658.
20. Zhang X, Han F, He Q, *et al*. Outcomes and risk factors for mortality after transfer from hemodialysis to peritoneal dialysis in uremic patients. *Perit Dial Int* 2008;28(3):313–314.
21. Lobbidez T, Crand A, Le Roy F, Landru I, Quééré C, Ryckelynck JP. Transfer from chronic haemodialysis to peritoneal dialysis. *Nephrol Ther* 2005;1(1):38–43.
22. Portolés J, Del Peso G, Fernández-Reyes MJ, Bajo MA, López- Sánchez P; GCDP. Previous comorbidity and lack of patient free choice of technique predict early mortality in peritoneal dialysis. *Perit Dial Int* 2009;29(2):150–157.

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